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Medical Aspects of Survival: Training for Aircrew

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NORTH ATLANTIC TREATY ORGANIZATION
 ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT
 (ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

AGARDograph No.283
 MEDICAL ASPECTS OF SURVIVAL:
 TRAINING FOR AIRCREW

by

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PREFACE

"Medical Aspects of Survival: training for aircrew", was intended to be a STANAG from the Aeromedical Working Party/Military Agency for Standardisation. However the preliminary draft became so extensive that it seemed more appropriate to publish it as an AGARDograph.

It is considered to be of importance to those responsible for the training of aircrew to have a coverage of the subjects of which the knowledge can be life-saving for the single person or the group in a survival situation.

The contents are based on many sources: official publications, locally prepared hand-outs from Survival Schools, discussions with others, and so on.

In view of this it is a pleasure to thank all those who have commented on the draft STANAG and whose remarks and suggestions have been included in the final manuscript.

I specially want to thank the Inspector General Medical Services of the Royal Netherlands Air Force, Commodore G.K.M. Maat, who has read the manuscript and shared his experience in writing this book.

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INTRODUCTION

Survival, for the purpose of this publication, is defined as "the return from any emergency in good physical and mental condition".

Medical aspects of Survival encompass those procedures and expedients :

- a. required and available for the preservation of health and the prevention, management and treatment of injuries and illnesses encountered during survival and
- b. suitable for application by nonmedical personnel to themselves or comrades within the reality of the survival situation.

It is more first-aid in the conventional sense. It approaches final definitive treatment in that it is not predicated upon the availability of technical medical assistance within a reasonable period of time.

The Survival Situation. There is no type "survival situation". Each situation is different ; reflecting highly specific interactions between the survivor and his environment and - as the case may be - influenced by the enemy. Thus, any approach to survival medicine must, of necessity, be flexible, emphasizing principles with sufficient specific examples to enhance practicality.

Survival Factors. Despite the variation among individual survival situations, factors may be categorized as follows :

- a. The Survivor - his mental and physical condition ; including his morale and will to survive, state of health, personal hygiene, illness or injury, and requirements for food and water.
- b. The environment - terrain, climate, flora and fauna, friendly or neutral natives, distance from friendly forces, and residuals from special weapons (i.e. chemical or radiological).
- c. The enemy - the actual presence or influence of the enemy, both in escape and evasion and POW compound situations.

Limitation and Exclusions. In the interest of pertinence and simplicity, this publication will be limited to the first of these three categories: the survivor, his health and well-being. The latter two factors - environment and enemy - will be considered only as they contribute to the causation of injury or disease, or modify application of treatment. Similarly, to avoid duplication of information generally available, the basic principles of first-aid will not be repeated.

The survivor is the most important member of his own rescue party as well as the most important of the three components of the survival system ; i.e. the man, his equipment and proper techniques. It is axiomatic, then, that the maintenance of his health and well-being is essential to successful survival. Survival is hard work, requiring peak mental and physical efficiency. Concurrently, survivors are subjected to a variety of "hostile" influences which reduce efficiency via illness and injury.

The magnitude of the medical problem in survival is indicated by past experiences where some 60 % of all survivors were already injured by the time they disentangled themselves from their parachutes or the wreckage of their aircraft. Almost 100 % had suffered some disease or injury by the time they were rescued. It was also noted that, while aircrew members generally knew how to administer first aid to others, there was a marked deficiency in the capability of the individual to administer first-aid to himself. Further, medical care beyond first-aid was not taught to aircrew members, despite the fact that many of them were on their own for long periods of time before medical attention was available. Survivors also reported that even minor injuries or ailments became major problems in the survival situation, prompt attention to minor conditions being even more important in survival than in ordinary situations.

The training of aircrew should therefore include the medical aspects of survival along with the other subjects as they always interact. Separate lectures concerning first-aid destroy the all important perspective.

CHAPTER ONE

MAINTENANCE OF HEALTH

The general state of health of the survivor has much to do with his resisting or recovering from the effects of disease or injury. A well-nourished human being, in good physical and mental condition, can tolerate a great deal before becoming incapacitated, and can recover satisfactorily from relatively severe disease or injury.

Water is most important in the survival situation. As most body functions occur in solution, adequate hydration is extremely critical. Even at rest in good health, the body requires some 1½ to 2½ litre of water daily. With fever, exercise, or hot weather, much larger amounts are required. Care must be taken, however, to ensure that water taken to maintain hydration does not introduce disease into the body due to inadequate purification.

Adequate nourishment is of triple importance in survival. Food contributes to morale and replaces body substances burned to provide energy for the hard work of survival. However, the well-motivated, well-nourished individual can survive a relatively long time using resources stored within his own body. While less appreciated, the replacement of salts, vitamins and other elements essential to health is of extreme importance, even during brief survival periods. These substances, required in small amounts, cannot be manufactured by the body, nor are they stored in any reasonable amounts. They are, however, quite important in maintenance of efficiency, resistance to disease, and in wound healing.

Salt is Essential to Health. Salt may be replaced by using salt tablets contained in some survival kits (as long as they last), from the meat, blood and body fluids of animals consumed, and in certain instance, salt found in water and the terrain. Salt should never be administered as a concentrated solution as such will cause nausea and vomiting, complicating the problem. If the blood and body fluid of animals are to be consumed, they should be thoroughly cooked (as should be the meat) to prevent infection with disease producing organisms. Even urine contains salts which may be useful in extreme situations. Salt should not be taken unless the water supply is ample. Salt requirements are increased in survivors vomiting, sweating or having burn wounds.

Vitamins Contribute to Continued Well Being. Vitamins and other essential elements are found in vegetable and animal food; frequently in the less palatable, most often discarded portions. Green and yellow vegetables are good sources of vitamins. Citrus fruits have long been recognized as good sources of Vitamin C which prevent scurvy and assist in wound healing. Other sources of Vitamin C include uncooked leafy green vegetables. Vitamin K (which is important in blood clotting) is also found in the leafy green portions of plants. The livers of most animals are rich in Vitamins A and D, which increase resistance to infection and aid in wound healing. Never use the liver of the polar bear and the bearded seal; these have an excessive vitamin A content which produces a toxic reaction. Other important elements are found in the liver and viscera of most animals. The survivor should eat as varied a diet as possible, discarding little, if any, of the food available to him.

Cleanliness is more than a virtue. In survival, it is essential to prevent infection. Washing, particularly the face, hands and feet, minimizes chances for infection of small scratches and abrasions. Handwashing, after defaecation and before eating, will reduce the opportunities for the introduction of infectious material into the mouth. Soap, although an aid, is not essential to keep clean. Ashes, sand, loamy soil and other expedients may be used in cleaning the body and utensils used in cooking and eating. Conventional tooth brushes, likewise, are not essential for cleaning the teeth. Adequate brushes may be improvised from twigs and other materials found in most areas, and should be used to preserve proper oral hygiene.

Adequate rest is essential in survival, especially for individuals who are sick or injured. Insofar as is compatible with the survival situation, regular rest periods should be scheduled and adhered to. One must beware of waiting until he is "dead" tired before going to sleep. Rest is particularly important in the initial stages of the survival situation when the individual is attempting to overcome the "shock" of the emergency and preparing his course of action.

Prevention. In addition to proper nutrition and personal hygiene, every possible preventive measure that is compatible with the survival situation should be taken to avoid either disease or injury. The phrase, "compatible with the survival situation", is necessary because frequently, the exigencies of survival will require that an injury be neglected temporarily. This is a matter of perspective. Other factors disregarded, even more attention should be devoted to field sanitation and safety than in the normal military situation. In survival, the least incapacity may initiate a chain of events leading to major disaster, due to the lack of outside assistance, including medical care.

CHAPTER TWO

MEDICAL AID TO SURVIVORS

Cessation of breathing.

Not breathing, regardless of its cause, is a dire emergency. Its alleviation consists of immediate removal of the cause and institution of effective artificial respiration. In the military survival situation, the most frequent cause of asphyxiation is blockage of the upper air passages due to face and neck injuries, drowning, choking, or inflammation and spasm of the upper air passages due to inhalation of smoke, flame or other irritating vapors. Other common causes are insufficient oxygen in the air, inability of the blood to carry oxygen and compression of the chest. An insufficiency of oxygen may be encountered when hiding in poorly ventilated caves or cisterns, or in the presence of a fire in an enclosed space.

The Airway. The first and most important step in restoration of breathing is the establishment of an open airway. Unless this is done, artificial respiration is fruitless; and, in favorable cases, restoration of the airway may permit the subject to begin breathing normally on his own. The patient must be removed from the cause of his breathing difficulty. The mouth is explored with a finger to remove any foreign material and to insure that the tongue is not obstructing the breathing passages. The most favorable position of the upper respiratory passages for breathing is with the lower jaw held well forward and the neck extended (head held slightly back).

Tracheostomy Technique. In some case of asphyxia (i.e. injuries of the face and neck or inflammation and spasm of the upper passages) an artificial airway must be established to save life. Tracheostomy can and has been done by lay personnel; and can and occasionally must be done in the survival situation when technical medical personnel are not available. In those extreme survival emergencies where it is indicated, anesthesia is unnecessary, the patient being unconscious already. Place the patient on his back with shoulders elevated so that the neck is extended and in a straight line. Locate the "Adam's apple" and the smaller projection just below it. Between these two projections is the desired point of incision. Using a sharp knife, make a deep horizontal cut in the exact midline, down to and into the trachea. This structure can be identified as "gristle" with the end of the finger. With this approach no significant bleeding should be encountered. Holding the trachea open insert a small section of pencil-sized rigid tubing, and anchor it into place with ties around the neck.

Mouth-to-mouth Respiration. The method of choice in artificial respiration is the so-called "mouth-to-mouth procedure." It is the only one which guarantees enough air exchange to revive the patient, while letting the "operator" insure that the airway is open. The method is much better demonstrated than described; and it should be practiced as the proper technique is not so simple as many think. With the patient on his back, the operator holds the jaw well forward with one hand bending the head back. The nose of the patient is occluded with the other hand. The operator places his mouth over that of his patient and exhales. If the airway is open, the patient's chest and abdomen are noted to expand. The operator then removes his mouth and permits the patient to exhale passively. This process is repeated at a rate of approximately 16 breaths per minute, the operator insuring that he does not over-breathe himself.

Cardiac arrest.

External cardiac massage. By means of external pressure on the front of the chest the heart can be squeezed rhythmically between the front and the back of the chest. This of course can only be done with the casualty lying on his back on a hard surface. Kneel beside him and place the hands - one on top of the other - over the lower part of the breast-bone. Keep the arms straight and with your height bear down sharply so that your hands depress the breast-bone about 2.5 to 4 cm then release the pressure. Press down once every second. After six cycles of massage perform one cycle of mouth-to-mouth respiration. Here also the method of cardiac massage is much better demonstrated than described. It should be demonstrated on a suitable dummy, for chest compression could be dangerous to a healthy person. As soon as the circulation has been restored mouth-to-mouth respiration should continue until the breathing has restarted naturally.

Control of bleeding.

Stopping the bleeding is most important in resuscitation, especially in survival situations where replacement transfusions are not possible.

Immediate steps should be taken to staunch the flow of blood, whatever its source. The method used should be commensurate with the type and degree of bleeding. Simple pressure over the bleeding point, with or without a dressing, will suffice in most cases, especially of the venous or capillary type. Minor arterial bleeding may also be controlled with the application of pressure. More protracted bleeding of the arterial type can be temporarily controlled by compression of the artery against a bone crossed in its normal course in the body. The location of standard "pressure-points" are detailed in all first-aid books.

The tourniquet, when required and properly used, will save life. If improperly used, it may cost the life, certainly the limb, of the survivor. The basic characteristics of a tourniquet and the standard methods of its use are well covered in standard first-aid texts; however, certain points merit emphasis in the survival situation. Every aircrewman should understand the correct improvisation and use of the tourniquet, on himself and others. The former is particularly important in survival situations because assistance may not be available. Never apply a tourniquet unless it is the only means by which the flow of blood from an injured extremity can be stopped. Once applied, leave it on until the bleeding vessel can actually be tied off. Frequent loosening, as formerly recommended, is now known to add little to the vitality of the extremity, but to cause loss of great amounts of blood, with resulting shock and death. The tourniquet should be applied as near the site of the arterial bleeding (on the body side of course) as possible, to reduce the amount of tissue lost, if the limb must be sacrificed to save life.

Find the Bleeder. An effort should be made to locate the bleeding artery so that it may be tied off, permitting release of the tourniquet. This is frequently very difficult. If the artery is completely severed, its ends may retract so as to be invisible in the wound. The wound should be cleaned with sterile (boiled) water and gently explored with a clean finger under direct vision in an effort to find the vessel. This is the one emergency reason for touching an open wound. Once located, the bleeding vessel should be securely tied with thread or fine string. Make sure that there is not more than one bleeding vessel. When reasonably sure that the bleeder is tied, cautiously relax the tourniquet and watch for resumption of bleeding. If more bleeding is noted, immediately tighten the tourniquet and proceed as before. If reasonably sure that the bleeder is in a given bit of tissue, the entire area can be tied off stopping the bleeding. This can be done by passing a large threaded needle into the tissue and around the suspected bleeding site and tying the entire mass securely. Generally, unless the single major blood supply of an extremity is involved, there is sufficient blood supply available from other vessels to maintain the life of the limb, regardless of these probabilities, one is still trading a limb for a life.

The control of pain.

Pain accompanying disease or injury under survival situations is both difficult and essential. In addition to its morale-breaking discomfort, pain contributes to shock and makes the survivor more vulnerable to enemy influences. Ideally, pain should be eliminated by elimination of its cause. However, this is not always immediately possible, hence measures for the control of pain are beneficial.

Position, Heat and Cold. The part of the body that is hurting should be put at rest, or at least its activity restricted to the maximum possible. The position selected should be the one giving maximum comfort, and the easiest to maintain. Splints and/or bandages may be necessary to maintain the immobilization. Elevation of the injured part, along with immobilization, is particularly beneficial in the throbbing type pain such as is typical of the "mashed" finger. Open wounds should be cleansed, foreign bodies removed and a clean dressing applied to protect the wound from the air and chance contact with environmental objects. Generally, the application of warmth reduces pain (i.e. toothache, bursitis, etc.). However, in some conditions, application of cold has the same effect (i.e. strains and sprains). Warmth or cold is best applied by using water due to its high specific heat, and the survivor can try both to determine which is most beneficial.

Pain-Killers. Drugs are very effective in reducing pain but are likely not to be available in the survival situation. Hence, the importance of the above "natural" procedures. Aspirin, APC's and such tablets are primarily intended to combat the discomforts of colds and upper respiratory diseases, and at best, will just take the edge off severe pain. They should be taken, however, if available. To be really effective in control of pain, stronger narcotic drugs such as codeine and morphine are required.

Morphine. Like the tourniquet, morphine, if indicated and properly used, can be life saving. It should be reserved for the most severe types of pain which do not respond to lesser measures. Morphine should not be used on patients who are unconscious, in deep shock, with breathing difficulties, with head injuries, or within two hours of previous injection. Nonmedical personnel should inject morphine into large muscle areas of the body, following the instructions contained on the syrette. A danger of multiple

doses of morphine in a cold shocked patient is that, with subsequent warming and improvement of circulation, an overdose may suddenly be absorbed into the system. One further precaution is indicated. Morphine converts a "walking wounded" into a "litter case" i.e. reduces the patient's capability for caring for his own needs. The impact of this on the survival situation is obvious. Aircrewmembers should be taught how to administer morphine to themselves as well as to others.

Shock.

Shock of some degree accompanies all injuries to the body, and, frequently it is the most serious consequence of the injury. In essence, shock is a circulatory reaction of the body as a whole to an injury, either mechanical or emotional. Whilst the circulatory changes initially favour body resistance to the injury by ensuring adequate blood supply to vital structures, they may progress to the point of circulatory failure and death. All aircrewmembers should be familiar with the signs and symptoms of shock, so that the condition may be anticipated, recognized and dealt with effectively. However, the best training approach is to treat all moderate and severe injuries for shock.

The sign of shock are :

- a. A state of collapse.
- b. An extreme pallor.
- c. A cold sweaty skin.
- d. Excitement and apprehension.
- e. The pulse is fast and weak.
- f. The breathing is fast and shallow.

The treatment of shock is :

- a. Lay the survivor flat and elevate the legs on something which will promote gravitational draining of fluids back into the direction of the heart.
- b. Arrest the haemorrhage.
- c. Administer morphine to the conscious (if severe pain is the likely cause).
- d. Dress the wounds.
- e. Except in the case of penetrating abdominal wounds, administer fluids by mouth if the patient is conscious (those which contain sugar are best, as sugar is a readily assimilable form of energy).
- f. Maintain body heat and remove from exposure. Do NOT overheat, and keep the patient very quiet. The pulse should be watched. If pulse action gets weaker and weaker after a 30 minute to 2 hour rest, there is not very much chance of recovery for evasive action. If the pulse is first weak, then steady, it is probably safe to move the patient to an evasion shelter for further rest.

Psychogenic Shock. Peculiar to the survival situation, is the shock so frequently noted during the period immediately following the causative emergency. This psychogenic shock, which occurs even without injury, requires attention to limit it, both in degree and duration. The degree of this post impact shock varies widely among individuals, but its incidence is almost universal. In reality, the survivor has passed through two major emergencies almost simultaneously ; the aircraft incident leading to the survival situation, and the situation itself. Should the survivor be injured (and the majority of them are) a third emergency is superimposed. It is not strange, then, that some psychogenic reaction with circulatory implications occurs. Resistance to this type of shock depends upon the individual's personality and the amount of training previously received. Management of such primary shock is important to keep it from progressing into more severe, irreversible secondary shock. The greater efficiency which follows the period of time used to relax and rest immediately after getting clear of the aircraft is well worth the delay in subsequent survival procedures.

CHAPTER THREE

GENERAL MANAGEMENT OF INJURIES

Proper immobilization of fractures, dislocations and sprains is of even more importance in survival medicine than in conventional first-aid. Rather than merely making the patient comfortable during transport to eventual treatment, in survival medicine the initial immobilization is part of the ultimate treatment. The contribution of proper immobilization of body parts to the control of pain and haemorrhage has already been cited. In addition, immobilization in proper position hastens healing of fractures, etc. and improves the ultimate functional result. In the survival situation, the immobilization expedient must suffice for a relatively long period of time, and permit the patient as a whole to maintain a fairly high degree of mobility. Materials for splinting and bandaging are available in most survival situations, and proper techniques are detailed in most first aid manuals. Experience has indicated that aircrew need more training in the application of splints and bandages to themselves should assistance not be available.

Infection is an omnipresent serious threat in survival medicine. The inevitable delay in definitive medical treatment, plus the reality of the survival situation, optimize chances for wound infection. Antibiotics, upon which modern medicine has become so dependent, may not be available in the survival situation, at least not in sufficient amounts. In survival medicine, one must place more emphasis on the prevention and control of infection utilising techniques followed prior to the advent of antibiotics.

Minimize Infection. Unfortunately, the survivor has little control over the amount and type of infection introduced at the time of injury. However he can exercise some control by ensuring that his clothing is clean, and is worn. Care must be exercised to prevent introduction of additional infection into wounds. Wounds, regardless of type or severity, should not be touched with the fingers or nonsterile instruments. One exception to this rule is the essential control of arterial bleeding, described above. Proper bandaging is necessary so as not to rub infection in from surrounding skin areas.

Clean the wound. All wounds should be promptly cleaned. Water is the most universally available and used cleaning agent, and that used should be clean, preferably sterile (boiled). Irrigation of the wound proper is preferred to hard scrubbing to minimize additional damage to the tissue. Foreign material should be washed from the wound to remove foci of continued infection. The skin adjacent to wounds should be washed thoroughly before bandaging. When water is not available for wound cleansing, the survivor should consider the use of urine. Urine may well be the most nearly sterile of all fluids available, and, in some cultures is preferred for wound cleansing.

Antiseptics. While soap is not essential to wound cleansing, the availability of a bar of medicated soap in the survival kit and used routinely, would accomplish much in preventing the infection of seemingly inconsequential injuries. External antiseptics (benzalkonium chloride tincture, etc.) are best used for cleaning abrasions, scratches and the skin areas adjacent to lacerations. Used deep in larger wounds, antiseptics produce further tissue damage.

The "Open Treatment" Method is the only safe way to manage survival wounds. No effort should be made to close lacerations or other tissue defects by sewing or other procedure. In fact, it may be necessary to open the wound even more (debridement - see below) to avoid entrapment of infection and to promote drainage. The term "open" does not mean that dressings should not be used. Good surgery requires that, although wounds are not "closed", nerves, bones and blood vessels should be covered with tissue. Such judgement may be beyond the capability of the aircrewmembers but protection of vital structures will facilitate recovery and ultimate function. A notable exception to "open treatment" is the early closure of facial wounds which interfere with breathing, eating or drinking (see below). Wounds, left open, heal by formation of infection resistant granulation tissue. This is easily recognized by its moist red granular appearance, a good sign in any wound.

Dressing and Bandages. After cleansing, all wounds should be covered with a clean dressing. The dressing should be sterile; however, in the survival situation, any clean cloth will suffice to protect the wound from further infection. A proper bandage will anchor the dressing to the wound and afford further protection. Bandages should be snug enough to prevent slippage, yet not constrictive to the part. Slight pressure will reduce discomfort in most wounds and aid in the staunching of bleeding. Once in place, dressings should not be changed frequently unless required. External soiling does not reduce the effectiveness of a dressing and there is certain pain and tissue damage associated with removing them, as well as the ever present danger of

infection during the changing process. Economy of means is another important consideration in survival.

Physiological "Logistics". Despite all precautions, some degree of infection is almost universal in survival wounds. This is the primary reason for the "open" treatment advocated above. The human body has a tremendous capacity for withstanding reasonable infections if it is permitted to do so. We have mentioned the importance of proper rest and nutrition to wound healing and control of infection. In addition, the "logistics" of the injured part should be improved. The injury should be immobilized in a position to favour adequate circulation, both to and from the wound. Constrictive clothing or bandages are to be avoided. Application of heat to an infected wound is a further aid, acting on local infections by promoting the exudation of body fluids from the wounds removing toxic products. Poultices, made of clean clay, shredded barks of most trees, ground grass seed, etc. serve the same purpose.

Adequate drainage of infected areas promotes healing. Generally, this can be done posturally and wicks or drains are unnecessary. On occasion, however, it may be advantageous to open an accumulation of pus (abscess) and insert light, loose packing to ensure continuous drainage. The knife, or other instrument used in making the incision for drainage, must be sterilized, even though the area is infected, to avoid introduction of other types of organisms. The best means of sterilization in the field is with heat, dry or moist.

Antibiotics, when available, should be taken for the control of infection. A continuing professional controversy involves how much of which antibiotic, if any, should be included in individual survival kits. Consensus is that the drug should be of the so-called "broad spectrum type", i.e. be effective against many microorganisms rather than specific for just one or two types. If an antibiotic is included, a sufficient amount should be provided for adequate dosages, rather than an ineffective token amount. The exact amount to be included will vary with the drug and basic assumptions as to the number and types of infections to be expected.

Debridement of severe wounds may be necessary to minimize infection (particularly of the gas gangrene type) and to reduce secondary or toxic shock. In essence, debridement is the removal of foreign bodies and all devitalized tissue. Tissue which does not bleed promptly upon incision is regarded as devitalized. The procedure requires skill and should be done by nonmedical personnel only in case of dire emergency. If it is to be done, the following general rules should be followed. Although skin is very important in ultimate closure of wounds, nonvital skin must be cut away. Muscles may be trimmed back to a point where bleeding starts and gross discoloration ceases. Fat which is damaged tends to die and should be cut away. Bone and nerve should be conserved wherever possible and protected from further damage. Ample drainage of the potentially infected wound must be provided and final closure deferred.

Amputation, in essence, is a specific and radical type of debridement, when all or part of an extremity is cut away from the body. It is indicated when there is massive damage to the limb posing the threat of overwhelming infection or shock. In deciding to amputate one is trading a limb for a life, and the decision should not be made lightly. Although all dead tissue must be removed, an emergency amputation should be done at the lowest possible level of live tissue, and the stump left open. If the site of amputation involves intact bone, some sort of a saw is needed. If none is available, consideration should be given to disarticulation (i.e. amputation through a joint). The flexible "wire saw" contained in certain survival kits may be used in dividing the bone during amputation.

Amputation technique. Only one type of emergency amputation is recommended - the open circular type -. Incision is made through the skin and underlying fascia at the lowest viable level, and the skin is allowed to retract. The muscle bundles are then severed at the new skin line. The muscle will promptly retract, leaving the bone exposed. The bone is then cut, dividing the limb. A tourniquet is normally required to control bleeding if the amputation is done through viable tissue. As blood vessels are identified, they should be grasped and tied, preferably before they are cut. The stump will resemble an inserted cone and should be left open with adequate provisions for drainage. A light bandage is applied to protect the stump from infection without interfering with drainage. Some sort of protective splint is then applied, extending well below the level of the stump.

The reduction of fractures is normally considered beyond the scope of first-aid; however, in the prolonged survival situation, the correction of bone deformities is necessary to hasten healing and obtain the optimal functional results. The best time for manipulation of a fracture is in the period immediately following the injury, before painful muscle spasm ensues. Traction is applied until overriding fragments of bone are brought into line, (check by the other limb) and the extremity is firmly immobilized. Frequently, it is advantageous to continue traction after reduction to ensure the proper alignment of the bones.

Improvised Casts. As plaster casts are not available in the survival situation, the improvisation of an immobilization device is necessary. This may be accomplished by use of several parallel pliable tree branches, woven together with vines or parachute lines. Care must be exercised so that the extremity is not constricted when swelling follows the injury. In the escape and evasion situation, it may be necessary to preserve the mobility of the survivor after reduction of his fracture. This is difficult in fractures of the lower extremities, although crutches may be improvised from the limbs of trees. With companions, the use of improvised litters may be feasible.

Reduction of dislocated joints is accomplished similar to that of fractures. Gentle, but firm, traction is applied and the extremity is manipulated until it "snaps" back into place. Should the survivor be alone the problem is complicated but not impossible. Traction can still be applied by exploiting gravity. The distal portion of the extremity is tied to or wedged into the fork of a tree or similar point of fixation. The weight of the body is then allowed to exert the necessary counter-traction, with the joint being manipulated until the dislocation is reduced. This same expedient can be applied in the reduction of fractures by survivors who are alone. However, before beginning the procedure, necessary splinting materials should be collected and placed ready for instant use.

Burns are frequently encountered in aircraft accidents, or during the survival episodes, and they pose serious problems. Burns cause severe pain, predispose to shock and infection, and offer an avenue for the loss of considerable body fluids and salts. The initial treatment is directed toward the relief of pain and prevention of infection. In the survival situation the closed method of treatment has certain advantages over the open treatment advocated in mass casualty situations. Covering of the wound with a clean dry dressing of any type reduces the pain and chances of infection. Further, such protection enhances the mobility of the patient and his capability for performing other vital survival functions. Suspensions of certain barks in water are alleged to soothe and protect burns via astringent action. This is a function of the tannic acid content of the bark used.

Maintenance of body fluids and salts is essential to the recovery from burns. The only route for administering fluids in the survival situation is by mouth, hence the casualty should ingest sufficient water, early, before the nausea and vomiting of toxicity intervenes. The restoration of electrolytes may require the ingestion of the blood of animals if salt tablets are not available. Even better would be the ingestion of solutions of salt and sodium bicarbonate. Burns of the face and hands are particularly serious in the survival situation as they interfere with the capability of the survivor to meet his own needs.

Lacerations (cuts) are best left open due to the probability of infection. They should be cleaned thoroughly, foreign material removed, and a protective dressing applied. Frequently, immobilization will hasten the healing of major lacerations. On occasion, it may be necessary to close the wound despite the danger of infection, in order to control bleeding or increase the mobility of the patient. If a needle is available, thread may be procured from parachute lines, fabric or clothing, and the wound closed by "suturing". If this is done, the stitches should be placed individually, and far enough apart to permit drainage of underlying parts. Do not worry about the cosmetic effect; just approximate the tissues. In scalp wounds, the hair may be used for closure after wound cleansing, infection being less a danger in this area due to the rich blood supply.

Sterilization. Instruments used in treating wounds, as well as other supplies in contact with wounds should be sterilized prior to use. In the field, heat, either wet or dry, is the most available and efficient means of sterilization. Instruments should be thoroughly cleaned, then boiled for at least 20 minutes prior to use.

CHAPTER FOUR

HEAT AND COLD EXPOSURE

Heat acclimatization. In certain climates the survivor will be exposed to considerable heat and must safeguard himself from its adverse effects. While the body can become acclimatized to heat, the process takes time, and the survivor must be especially careful during the first week of his experience. There are three specific types of heat illness and they will be summarized in turn.

Heat cramps are due to excessive losses of salt from the body. There is painful cramping of the muscles of the extremities and abdomen, but the body temperature remains normal. Treatment involves replacement of the salt. A 0.1 % solution of salt in water (two tablets in a canteen of water) is better tolerated than taking the tablets straight. Recovery is rapid.

Heat exhaustion is a form of shock and is due to excessive losses of both salt and water from the body. It is manifested by headache, dizziness, confusion, drowsiness and weakness after heat exposure. The skin is cool, pale and wet with perspiration. Treatment is the same as for any other type of shock, plus replacement of salt and water as above.

Heat stroke is a serious medical emergency, and if not treated immediately and forcibly, death will intervene. In heat stroke body heat loss is inadequate, the body temperature rises, and the heat regulating centre in the brain is damaged and ceases to function. The skin is dry, hot and flushed; the patient collapsing suddenly. The body temperature must be lowered immediately by whatever means possible. In the survival situation, the most available treatment may be stripping off all clothing, pouring water on the patient, and fanning him to promote evaporative cooling. It should be obvious that heat injuries are much better prevented than treated.

Cold injury. In other climatic extremes the problem of cold injury becomes more important. The body attempts to prevent excessive loss of heat in vital parts by decreasing blood flow to superficial tissues. Blood vessels constrict until blood flow is inadequate to maintain tissue health. Further, extreme cold has a direct harmful effect on tissues.

Hypothermia follows the exposure of the entire body to extreme cold as in immersion following over-water emergencies. There is a significant drop in body temperature until vital functions cease. The patient must be rewarmed immediately if he is to survive. He should be exposed to a temperature of 40 - 43° C. This may be accomplished using warmed water (feels warm to skin of forearm) or a warmed room. The difficulties of managing this condition in the survival situation are most obvious.

Frost Bite is a local tissue death from exposure to cold below freezing (usually below -10°C) for relatively brief periods (a few hours). Symptoms of frost-bite are :

- a. a dull whitish pallor of the skin ;
- b. with deep freezing the tissue becomes immovable and solid ;
- c. A prolonged exposure will cause numbness, blurring of vision and even unconsciousness and finally respiration may cease.

Treatment of the parts involved should be prompt. Never rub the injured part or massage it with snow or anything else. Rewarming to 32 - 40° C as soon as possible is advisable. This may be accomplished by placing the injured part against or between other warm parts of the survivor's or someone else's body or in warm water.

Trench (or immersion) foot is local tissue death from exposure to cold above the freezing temperature usually 0- 5° C and to dampness for longer periods of time (48 hours or longer). Constricting clothing must be removed and the part rewarmed to + 25° C. If water is used it should feel slightly cool to the forearm. The injured part should be protected with dry dressing and the patient treated as a litter case if it all possible. The aim is to prevent further damage and infection.

Prevention of cold injury. As in heat injury, cold injury is much better prevented in the survival situation, than treated. The survivor should avoid wind and moisture to the maximum extent. The buddy system aids in detecting frost bite early. Tight constricting clothing and foot-gear are dangerous. Feet and socks should be kept dry and toes exercised. Periodic elevation of the feet in immobilized situations aids in maintenance of adequate circulation.

CHAPTER FIVE

SPECIFIC INJURIES

Injuries about the head pose additional problems related to brain damage as well as interference with breathing and eating. Bleeding is more profuse in the face and head area, infections therefore are less likely. This makes it somewhat safer to close wounds earlier to maintain functions. Tracheostomy, as described above may be necessary if breathing becomes difficult due to obstruction of the upper airways. In the event of unconsciousness, the patient must be watched closely and kept still. Even in the face of mild or impending shock the head should be kept level or even slightly elevated if there is reason to suspect brain damage. No fluids nor morphine should be given to unconscious persons.

Wounds of the abdomen are particularly serious in the survival situation. Such wounds, without immediate and adequate surgery, have an extremely high mortality rate, and render the patient totally unable to care for himself. If guts are not extruded through the wound a secure bandage should be applied to keep this disastrous event from occurring. If guts are extruded, it is best that they not be replaced, due to the almost certain threat of fatal peritonitis. The extruded bowels should be covered with a sterile dressing which is kept wet with any fluid that is fit to drink. The patient should lie on his back and avoid any motions that increase inter-abdominal pressure which might extrude more bowel. He will have to be cared for in an immobile state or moved on a litter. "Nature" will eventually take care of the problem either through death, or walling off the damaged area, sloughing of the loop of extruded gut and establishment of a traumatic colostomy (artificial anus).

Injuries of the chest are common, painful and disabling. Severe bruises of the chest or fracture of the ribs require that the chest be immobilized as far as possible to prevent large painful movements of the chest wall. All first aid courses teach the proper technique of wrapping the chest. The bandage is applied while the patient deeply exhales. In the survival situation, it may be necessary for the survivor to wrap his own chest. This is more difficult but can be done by attaching one end of the long bandage (parachute silk) to a tree or other fixed object, holding the other end in the hand, and slowly rolling the body toward the tree, keeping enough counter pressure on the bandage to insure a tight fit.

Sucking chest wounds. (communication between the pleural cavity and the outside) are easily recognized by the sucking noise, appearance of foam or bubbles in the wound, and the severity of the shock. These wounds must be closed immediately before serious respiratory and circulatory complications occur. Ideally, the patient should attempt to exhale holding his mouth and nose closed (Valsalva) as the wound is closed. This inflates the lungs and reduces the air trapped in the pleural cavity. Frequently, a tightly taped dressing is all that is needed, but sometimes it is necessary to put in a stitch or two to make sure the wound is closed.

Eye injuries are quite serious in the survival situation due to the pain and interference with other survival functions. The technique for removing foreign bodies, and for preventing snow blindness are covered in standard first-aid manuals. More serious ocular injuries involving disruption of the contents of the orbit, should be covered with a dry clean dressing. Enucleation (taking the eye out) should be undertaken only by the experienced surgeon.

Thorns and splinters are frequently encountered in the survival situation. Their danger is minimized by the wearing of gloves and proper footgear. Their prompt removal is quite important to prevent infection. Wounds made by these agents are quite deep compared to their width which increases chances of infection by those organisms (such as tetanus) which grow best in the absence of oxygen. Removal of splinters is facilitated by the availability of a sharp instrument (needle or knife) or long nosed pliers or tweezers. Care must be taken to get all the foreign body out, and it is sometimes best to extend the width of the wound to permit proper cleansing and the entrance of air. When cleaned, treat as any other wound.

Blisters and abrasions should be cared for promptly. Foot care is extremely important in the survival situation. Should redness or pain of the foot be noted, the survivor should stop (if at all possible) to find and correct the cause. Frequently a protective dressing or bandage and/or adhesive plaster will be sufficient to prevent a frank blister. If a blister does occur, the top should not be removed. A sterile (or clean) dressing should be applied. Small abrasions should receive attention to prevent secondary infection. The availability of soap with a mild antiseptic for routine uses in

the survival situation will minimize the infection of small abrasions which may not come to the attention of the survivor.

Bites of insects, leeches, etc. pose several hazards. Many of these organisms transmit diseases; and the bite itself is likely to become infected, especially if it itches and the survivor scratches it. The nuisance problem is well appreciated by all who have lived in the woods, and survivors are particularly vulnerable to nuisance. The body should be inspected frequently for ticks, leeches etc., and these should be removed immediately. The survivor should avoid areas known to be infested with leeches, ticks, etc. Traditionally, these parasites are removed by applying heat or other irritant to them to encourage relaxation of their hold upon the host. Then the entire organism may be gently detached from the skin, without leaving parts of the head imbedded. Such wounds should be treated as any other. The application of cold wet dressings will minimize the itching, scratching and swelling.

Snake Bite. Standard treatment of snake bite is well described in first-aid manuals. The patient should lie down and be kept motionless. A snug tourniquet (tight enough to impede the venous return of blood to the body, yet loose enough to allow arterial supply to the extremity) will further delay systemic absorption of the poison. The affected body part should be kept in as high a position as possible above heart level. Similarly, the application of cold wet packs to the site of the bite will delay absorption of the toxin. Active treatment consists of making small but deep "X" shaped cuts at each fang mark and sucking out the poison. A possible exception is in the case of snake bites sustained in the warm moist tropics where any skin wound bears a high risk of infection. Mouth suction is much more effective than devices contained in snake bite kits.

CHAPTER SIX

SURVIVAL ILLNESSES

Illnesses, as well as injuries, take their toll among survivors. Here again, perspective is all important. Many illnesses, considered minor in the standard medical environment, become major in survival when the man is on his own and without medication or medical care. This should be emphasized in all survival training to motivate potential survivors to use standard methods for the prevention of expected diseases, knowing that their treatment in the survival situation is so difficult. On the other hand, most of the diseases to be encountered existed long before the availability of modern medicaments and people did survive with them.

Food poisoning is a perennial threat to survivors. Due to the sporadic availability of food it is desirable that the portion not immediately consumed be stored for future consumption. "More urgent" requirements tend to place sanitation second. The best method of food preservation varies with the global area and tactical situation, but it must be adequate. Bacterial contamination of food causes much more difficulty in survival than the ingestion of so-called poisonous plants and animals. Similarly, dysentery and other water-borne diseases may be controlled by proper sanitation and personal hygiene. Such sanitation and hygiene measures seem to increase in difficulty as they become more necessary to survival.

Treatment of Food Poisoning. If the food poisoning is due to preformed toxin (acute symptoms of nausea, vomiting and diarrhoea soon after ingestion of the contaminated food) the best treatment is supportive. Keep the patient quiet and lying down, and ensure that he drinks sufficient water. If the poisoning is due to ingestion of bacteria which grow within the body (delayed gradual onset of same symptoms) antibiotics (if available) should be taken. In both cases, symptoms may be alleviated by the ingestion of small amounts of fine clean charcoal frequently. The charcoal may be powdered from the remains of fires used for warmth or cooking. In POW situation chalk (used for "orientation" etc.) may be procured, reduced to powder, and ingested to coat and soothe the intestines. Proper sanitation and personal hygiene should prevent the spread of infection to others in the party or continued reinfection of the patient.

Respiratory diseases, influenza, colds etc. are particularly dangerous in POW situations where large numbers of men are crowded together in poorly sanitized, unventilated shelters. Symptomatic treatment consists of APC's (if available); there being no specific definitive medication, even under normal conditions. Maintenance of health and stamina, adequate rest, and proper nutrition all increase individual resistance. The proper heating and ventilation of shelters reduces the spread of infection among groups. Use of barrier partitions and distance reduces droplet contamination of others from a clinical case.

Malaria is likely to be encountered in many parts of the world. Selection of camp sites and travel routes aid in avoiding the mosquito vector of the disease, as does the wearing of proper head nets, other protective clothing or the use of skin or clothing repellents. Chloroquine tablets, contained in most survival kits, may be used for both the suppression and treatment of malaria.

Typhus, a serious disease transmitted by lice, poses a problem in the POW situation or when utilizing native huts for shelters. A disease of poverty and overcrowding, it is best prevented by personal hygiene, sanitation and avoiding native villages. Immunization is available against this disease and should be provided to aircrew who might be exposed to survival situations, especially in time of war.

Scabies, another condition associated with poor personal hygiene and crowding, pose a problem in the POW situation. Scrupulous cleanliness and the avoidance of infected persons offer the best protection. Avoidance of sharing of clothing and bedding also limits the spread of scabies and other parasitic infestations. Scabies lesions, itching intractably, are easily infected and may cause actual disability. While scratching may kill an occasional parasite in the skin burrows, it inoculates many others into uninvolved skin areas. Scabies is not likely to be a problem for the survivor on his own and not associated with other human beings.

Other skin infections and infestations prove troublesome in the survival situation. Strains of organisms vary throughout the world, and the survivor exposed to skin contaminants against which he has no acquired resistance, may develop severe pimples, boils and other infections. Resistance quickly develops, but the survivor must be especially careful of his skin care during the period of acclimatization. Sweating, through its macerating and hydraulic actions, renders the skin even more liable to infection; a problem common in the jungle. The management of skin infections involves repeated gentle cleansing of infected areas, protection of them from trauma and reinfection, and general hygiene. If antibiotics are available, they may be taken.

Carbon Monoxide. A warning regarding carbon monoxide poisoning is indicated. This survival hazard is one that the survivor generates for himself. In cold climates, trying to conserve fuel, the survivor may fail to provide adequate ventilation of his shelter. Carbon monoxide accumulates, and even in small amounts is quite dangerous. Its onset is quite insidious and effects are quite prolonged. The treatment of the condition is immediate removal of the patient into the open air, and assisting his breathing by artificial resuscitation, if indicated. Due to the affinity of carbon monoxide for the oxygen carrying cells of the blood, artificial respiration may have to be continued for some time before the individual recovers. While most causes of cessation of breathing render the subject blue, carbon monoxide frequently leaves him with a pinkish skin coloration, especially the lips and cheeks. The best prevention is to ensure adequate ventilation of all fires, regardless of the climatic condition.

CHAPTER SEVEN

ESCAPE AND EVASION, MEDICAL ASPECTS

Enemy Influence. In escape and evasion, the presence or influence of the enemy compounds the survival medicine problem. While the general survival medicine principles and techniques summarized above remain unchanged, their application is made difficult.

Increased risk. In the escape and evasion situation the survivor is more likely to become sick or injured. Illnesses and injuries sustained are more likely to become complicated or aggravated due to the pressure of other over-riding requirements. The survivor is rendered less mobile, and at the same time is paradoxically prohibited from remaining in one place for very long periods. The impact of this situation upon the care of illness and injury is readily apparent. The survivor has less freedom of action in selecting his bivouac sites and escape routes ; and has more difficulty in securing the food and water necessary to his well-being. It is more difficult to secure proper shelter and to build necessary fires. Proper sanitation is still further compromised.

Mobility. Equipment-wise, the aircrewman who must leave the vicinity of his aircraft is in an unfavorable situation. He is limited to those items which he can carry without jeopardizing his escape. He must establish his own priorities as to what to take and what to leave. Fortunately, medical items are light and small in volume.

Group versus Individual. Should the survivor become incapacitated, it is more difficult for him to care for himself. His comrades, if any, may be reluctant to remain with him or to impede their own evasion efforts by carrying him along, as such might jeopardize the escape and evasion of the entire group. Similarly, in the interest of military success, how much of a given survivor party's means (including medical) should be left with a member who must be abandoned due to incapacitation ? Certainly, the escape of the party should not be jeopardized by stripping it of vital survival means. An important adjunct to the management of survival illnesses and injuries is rest for the entire body, as well as the injured member. This is difficult, if not incompatible with the escape and evasion situation.

Conflicting Priority. Here, particularly, perspective is important. As important as the prevention and care of illness and injury is avoidance of capture by the enemy. This is not a new concept. In conventional peacetime survival situations, evacuation from the aircraft is given priority over first-aid for individual casualties. Further, in time of war, the welfare of several cannot be jeopardized for the good of one. Thus, it may be desirable for an escaping party to abandon an incapacitated member rather than risk capture of the entire group.

Do not further incapacitate ! One general medical principle seems to apply to the escape and evasion situation. Nothing that will hinder the ability of a casualty to care for himself should be done. Examples might include bandaging both eyes because one is injured and it is desired that it be immobilized ; and the administration of morphine, converting a "walking wounded" to a "litter case". Survival medicine is an accepted compromise ; this is certainly true in the escape and evasion situation.

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